

unmistakably clear words of penetrative genius and the brilliantly faceted phrases of clever men, and which is contributed by the author, is, however, of another kind: rather fluorescent than luminous, and by no means transparent.

Not that the author is without some literary deftness and incapable of pressing home a plain fact in a convincing manner. Thus, for instance, where he acknowledges his indebtedness for embodying so large a part of Geddes and Thompson's well-known work on "Sex and Evolution," explaining that it would be mere presumption on his part to attempt to do again what they have already done far better than he could do. Reading the book, it is soon clear that this is true, and, as of great relevance, a truth as well stated although otherwise evident. That it is stated well no one will deny.

The author's own meaning is presumably contained in the commentary paragraphs that follow each of these lengthy quotations. The redundancy of reiterated references to "parasitism" contained within these comments is reminiscent of a well-known dialogue between two dramatists unfortunately departed to the nether-world and there contesting their respective excellences in metrical statement. Entitled to one line with which to conclude his fellow competitor's heroic verse, one candidate secures a repeated success by the use of always the same phrase, some such simple phrase as "and I lost a little oil-can."

From these reiterated comments it would appear that parasitism is responsible for many things, chiefly perhaps for "the passing of natural selection." This is by no means surprising when the author's comprehensive concept of "parasitism" is fully grasped. The term is defined as connoting

"Every condition whereby one organism lives precariously, stealthily, or indolently, i.e. retrogressively, by the work of others. In view of the dynamic interdependence of life, the epithet must also apply to all transitory phases of violation of fundamental laws of assimilation and division of labour, even the highest and most strenuous organisms occasionally being guilty of such transgressions."

To this definition there are, however, so many numbered corollaries that "parasitism" is by no means understood until wider reference is made. Briefly, let it be said that there is the whole work to refer to.

Herbert Spencer, so it would seem, has anticipated this intellectual venture in a somewhat remarkable manner. Thus the author quotes his explanation of the limits to cell-growth in terms of an increasing disparity between mass and surface, and appends the following comment: "Herbert Spencer here very lucidly, though unwittingly, states the case of pathology and parasitism, and consequent limitations."

The author deliberately stating this case, so it would seem, is by no means so clear, and as a consequence places difficulties in the way of that criticism which he foresees apparently without fearing.

"Anyone honestly wishing to challenge my views is, of course, very welcome to do so. But if criticism is to be effective, it must state categorically in what

particulars I am wrongly interpreting observed facts, and must also show that my physiological position is unsound."

This statement may become more pregnant when the author has detailed these particulars, and provided a view of his physiological position.

J. S. MACDONALD.

THE DIVINING ROD.

Graf Carl v. Klinckowstroem. *Bibliographie der Wünschelrute*. Mit einer Einleitung von Dr. Ed. Aigner: der gegenwärtige stand der Wünschelrutens-Forschung. Pp. 146. (München: Ottmar Schön-huth Nachf., 1911.)

THIS book contains a fairly complete list of the various publications in regard to the divining-rod, beginning with the work of R. P. Bernhardus, published in 1532, and ending with papers issued during the current year. This list extends over 103 pages, and the contents of each book or paper are indicated by a brief note following the title of the publication.

The list is naturally more complete in respect of German publications than of any others; there is a useful index giving the names of the various authors who are mentioned. The thanks of those who are interested in the matter are due to Graf von Klinckowstroem for the care he has taken in collecting the information and presenting it in useful form. There is also an interesting introduction by Dr. Eduard Aigner, of Munich, who endeavours to sum up impartially the present condition of matters in connection with research on the action of the divining-rod. He points out quite correctly that the attitude of those who refuse to investigate the matter at all is just as absurd as that of their opponents, who are willing to accept all the claims of the "diviners" without further investigation.

Dr. Aigner also points out that a certain percentage of failures does not necessarily prove that the "diviners" do not possess the powers they claim, for if these powers have any real existence, they may be conditioned by circumstances at present unknown to us, and one may be at times asking the "diviners" to perform experiments under impossible conditions.

An explanation of the recorded successes of "diviners" is suggested, which presupposes the power of the "diviners" to recognise the difference produced in the atmosphere by the presence of water, metals, &c. The most important argument in favour of this is based on the investigations of Dr. Kurz and Prof. Gockel (*Physikalische Zeitschrift*, x., p. 845) and of T. Wulf (*idem*, x., p. 997), in which a lessening of the gamma-radiation over water is said to be proved. This lessening is said to take place over quite insignificant water-sources.

If this view were correct, it ought, of course, to be possible to produce a physical apparatus capable of replacing the "diviner," and several articles of this kind are on the market. The reviewer has applied for permission to test some of these, but he has not so far succeeded in inducing those concerned to allow him to do so. Dr. Aigner says that successes of one

form of apparatus are spoken about, but that they do not appear to have been verified by competent authority.

The reviewer is of opinion that further experiments are desirable, and that these should be directed mainly towards ascertaining whether or not the movements of the "diviner's" rod are caused by any influence outside himself. The experiments are difficult to carry out, because it is clearly fair that the conditions should be those acceptable to the "diviner"; these vary greatly, few "diviners" being entirely in agreement when asked to describe clearly the extent of their powers.

J. WERTHEIMER.

DIOPHANTINE ANALYSIS.

Diophantus of Alexandria: a Study in the History of Greek Algebra. By Sir T. L. Heath, K.C.B. Second edition, with a Supplement containing an Account of Fermat's Theorems and Problems connected with Diophantine Analysis and some Solutions of Diophantine Problems by Euler. Pp. vii+387. (London: Cambridge University Press, 1910.) Price 12s. 6d. net.

THIS is far from being a mere reprint of the first edition; in fact, it is in great part a new work, which, in conjunction with Tannery's critical edition of the "Arithmetica," makes Diophantus at last accessible to the ordinary reader.

The introduction, besides giving a historical account of Diophantus, the MSS. of his works, and the writers who have dealt with them, contains most interesting and valuable sections on Diophantus's notation and methods of solution. As to the first, we are astounded, as in the case of Archimedes, at the ease with which enormous numbers are computed, in spite of the cumbrous Greek notation. An instance in point is the famous cattle problem (attributed to Archimedes), which is briefly discussed on pp. 121-4. Its solution involves the Pellian equation $t^2 - 4729494u^2 = 1$, and according to Sir T. Heath's calculations, the value of one of the unknowns of the problem would be a number containing 206,545 digits. Of the methods of Diophantus not much can be said, because he uses so many ingenious devices to suit different problems; but we may note his dexterity in choosing his unknown quantity, and his curious plan of "working back" by a sort of rule of false position. A good example of the latter is v. 29 (p. 224): "To find three squares such that the sum of their squares is a square," where it will be seen that an insufficient assumption is corrected and modified in a sort of tentative way until a solution is found.

It would be unprofitable to go into any detail here on the nature of Diophantine problems in general; to appreciate them it is necessary to read Diophantus, Fermat, and Euler. By a very happy inspiration, the present volume has been made to include all the notes of Fermat upon Diophantus, and extracts from his correspondence with Frénicle and others; besides this we have solutions of seventeen Diophantine problems by Euler, which are models for those who

feel inclined to work in this fascinating field. There can be little doubt that there are still numbers of arithmetical problems to be solved by Diophantine methods, and Fermat's method of reduction (*descente*) for proving the impossibility of certain indeterminate equations awaits rediscovery and development. Moreover, the theory of algebraic forms and symmetric functions ought surely to lead to new arithmetical applications of a Diophantine type. To give an example of the sort of thing we mean: Let x, y, z be three variables; we have identically

$$\Sigma x(y-z)^3 = (y-z)(z-x)(x-y)(x+y+z).$$

Now put $x, y, z = \xi^3, \eta^3, \zeta^3$, and suppose that $\xi^3 + \eta^3 + \zeta^3 = m\xi\eta\zeta$; then the previous identity leads at once to

$$A^3 + B^3 + C^3 = mABC$$

with

$$A, B, C = \xi(\eta^3 - \zeta^3), \eta(\zeta^3 - \xi^3), \zeta(\xi^3 - \eta^3).$$

This is a partial sample of what Fermat would call a *descente*; of course, it is now well known as the theory of residuation of points on cubic curves, but it is interesting to see how it results from an elementary algebraic identity, and there are still arithmetical problems in this connection which do not appear to have been solved.

It may interest those who are unacquainted with the subject to give one typical Diophantine problem and its solution. The problem is "To find two positive integers such that their sum is a square, and the sum of their squares a biquadrate." One solution is (4565486027761, 1061652293520), and it has been proved by Lagrange that, as Fermat "confidently asserted," this is the simplest solution. More exactly: the same problem may be put in the form, "Find a right-angled triangle such that the hypotenuse and the sum of the sides are both squares," and Fermat's assertion was that the above solution gave the smallest of such triangles.

In conclusion, it may be remarked that there is a *crux* in the Greek text which does not seem to have been finally disposed of. After putting the problem, "To find two numbers such that their sum and product are given numbers," Diophantus adds the condition, "the square of half the sum must exceed the product by a square number." *ἔστι δὲ τοῦτο πλῆσματικόν*. It would be possible to translate this, "This is artificial" (as opposed to "natural"), but there does not seem to be any point in this. On the other hand, to translate "This can be seen from a model" would give good sense, because we should only have to replace a diagram in Euclid by a corresponding arrangement of counters; unfortunately, this seems to read more into the text than is legitimate. Neither of these alternatives is proposed in the note on p. 140; the editor prefers, on the whole, Xylander's *effictum aliunde*, which is not far in sense from "artificial," in the context. The same phrase occurs in two other places, and in each case we can give a quasi-geometrical arrangement of counters to show that the condition is necessary; so far, this is in favour of the second alternative suggested above.

G. B. M.